

SECTION 15403
MEDICAL GAS SYSTEM

PART 1 - GENERAL

- 1.1 APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.
- A. American National Standards Institute (ANSI) Publications
 - B. American Society for Testing and Materials (ASTM) Publications
 - C. American Welding Society (AWS) Publications
 - D. Compressed Gas Association (CGA) Publications
 - E. The Copper Development Associations (CDA) Publication
 - F. Manufacturer's Standardization society of the Valves and Fittings Industry (MSS) Publications
 - G. National Fire Protection Associations (NFPA) Publications
- 1.2 GENERAL REQUIREMENTS: Section 15000, "Mechanical General Provisions", applies to this section with the additions and modifications specified herein.
- 1.3 DESCRIPTION OF WORK: The work includes providing new and modifying existing medical gas and vacuum systems and related work. Provide each system complete and ready for operation. The system, including oxygen, medical air, vacuum, nitrogen, and nitrous oxide piping, equipment, materials, installation, workmanship, examination, inspection, and testing, shall be in accordance with the provisions of the National Fire Protection Association, except as modified herein.
- 1.4 SUBMITTALS
- A. Comply with Section 15000, Mechanical General Provisions.
 - B. Manufacturer's Data:
 - 1. Pipe and Fittings
 - 2. Valves
 - 3. Specialties
 - 4. Outlets
 - 5. Oil Free Dry Nitrogen

- 6. Recessed Valve Boxes
 - 7. Alarm Panel
- C. Certificates of Conformance:
 - 1. Test Instruments
 - 2. Medical Gas Systems Testing Agency
 - 3. Welder and Brazers Qualifications and Procedures
- D. Medical Testing Agency Reports:
 - 1. Cross Connection Tests
 - 2. Alarm, Switchovers, Pressure Switch, and Equipment
 - 3. Final Purging and Testing
 - 4. System contaminate Level Tests
 - 5. Holding Charges
- E. Contractor Test Report:
 - 1. Positive Pressure Tests (Include leak tests)
 - 2. Vacuum Systems Tests
- F. Operation and Maintenance Manuals:
 - 1. Medical Air Systems
- G. Posted Operating Instructions:
 - 1. Piping Systems Diagrams
 - 2. Medical Air Systems

1.5 SAFETY

- A. Welding, Brazing, and soldering: ANSI Z49.1

PART 2 - PRODUCTS

- 2.1 MANUFACTURERS: Manufacturers shall be as indicated or approved equals.
- 2.2 PIPE AND FITTINGS: Sized and made for pressures and other design conditions as indicated.

- A. Oxygen, Medical Air, Nitrous Oxide, Nitrogen, and Vacuum Systems
 - 1. ASTM B88 or ASTM B280 ACR (air conditioning and refrigeration), seamless Type K or L hard-drawn copper tubing for above ground and inside buildings. Standard weight (Schedule 40) brass pipe per ASTM B43 may be used. Use ANSI B16.18 cast copper, ANSI B16.22 wrought copper, or brass fittings.
 - B. Oxygen, medical air, nitrous oxide and nitrogen pipe shall be provided from the manufacturer certified clean for oxygen service. Piping intended for vacuum service is exempt from this requirement only if the contractor can ensure it will not be inadvertently used in the medical gas distribution system.
- 2.3 VALVES: NFPA 99, sized and made for pressures and other design conditions as indicated. Valves used for oxygen, medical air, nitrogen oxide or nitrogen service shall be provided from the manufacturer certified clean for oxygen service. Valves intended for vacuum service are exempt from this requirement only if the contractor can ensure they will not be used in the medical gas distribution system.
- A. Ball Valves: NFPA 99 bronze or stainless steel body as applicable, double-seal ball valves with replaceable Buna-N, neoprene, or polytetrafluoroethylene (TFE) seat seals. Valves shall be suitable for at least 300 pounds per square inch gauge (psig), non-shock working pressure, designed especially for the service intended. Mount valves in the line between flanges or unions. Valves of same type shall be the product of one manufacturer, uniform in pattern and appearance, and labeled for the intended service.
 - B. Diaphragm Valves (Oxygen, Nitrous Oxide and Nitrogen): MSS SP-88, brass-bodied, packless, diaphragm type with regrindable or renewable seats and disks capable of being disassembled in line for servicing o-ring and seating surfaces. Valves shall be suitable for at least 300 psig, nonshock working pressure.
 - C. Gate Valves: (Vacuum and Medical Air Systems): MSS SP 80, bronze solder ends; or MSS SP 81, stainless steel, welded ends. Valves of like kind shall be of one manufacturer.
- 2.4 SPECIALTIES
- A. Hangers and Supports: Steel adjustable type per MSS SP-58 and MSS SP-69. Provide hangers, supports, nuts, bolts, and washers with hot-dip galvanized finish after fabrication.
 - B. Piping Isolators: Commercial metal clad hair felt type for isolating pipe from hangers.
 - C. Vacuum Bottle Brackets (Slides): Stainless steel, chrome-plated metal, or aluminum with finish matching adjacent outlet.
 - D. Flexible Connectors: Manufactured expressly for operating conditions either (1) annularly and helically corrugated flexible, single ply, seamless or seam-welded tubing with one or more layers of stainless steel or bronze wire braid, or (2) reinforced TFE bellows or hose. Use manufacturer's recommended lengths and sizes for the intended service.

- E. Sleeves: 1/4 inch clearance around pipes.
 - 1. In Concrete and Masonry: Galvanized steel pipe.
 - 2. Partitions, Floors and Roofs, other than Concrete or masonry: 26-gauge galvanized sheet steel
 - F. Brazing Alloy: AWS A5.8, BCuP Series. Brazing filler metal shall be cadmium free.
 - G. Soldering Alloys: ASTM B 32, alloy Grade Sb5 or equivalent.
 - H. Welding Filler Metal: AWS A5.28 and compatible with the materials.
 - I. Piping Identification: Pressure sensitive adhesive tape and decals. Colors and labels shall conform with CGA Pamphlet C-9.
 - J. Nitrogen: For cleaning, purging, and testing use oil-free dry nitrogen as specified in paragraph entitled, "Test Gases".
- 2.5 OUTLETS: Sized and made for pressures and other design conditions as indicated.
- A. Quick-Connect Medical Gas Wall Outlet
 - 1. The quick-connect Medical Gas wall/ceiling outlets shall be gas specific for the services indicated and accept only corresponding quick-connect adapters. The outlets shall be UL listed, CSA certified, and be fully compliant with the latest edition of NFPA 99. All outlets shall be 100% tested for flow, leaks and connector attachment. The outlets shall be cleaned for oxygen service prior to shipping. The outlets shall be made in the U.S.A. A die cast, light gray, epoxy powder coated trim plate shall be provided to trim each wall/ceiling outlet and to fill the space between adjacent outlets. The trim plate shall allow latch valves to be individually removed for servicing.
 - 2. Outlet Design: A complete medical gas outlet shall consist of a gas-specific rough-in assembly for installation before the wall is finished and a matching gas-specific latch-valve assembly and cover plate for installation after the wall is finished.
 - 3. Rough-in Assembly: The rough-in assembly shall be of modular design and include a gas-specific 16-gauge steel mounting plate designed to permit on-site ganging of multiple outlets, in any order, on 5" centerline spacing. A machined brass outlet block shall be permanently attached to the mounting bracket to permit the 1/2" OD (3/8" nominal), type K copper inlet tube to swivel 360° for attachment to the piping system. Gas service identification shall be affixed to the inlet tube and the face of the mounting plate. A secondary valve shall be installed in the outlet block of the rough-in assembly for both pressure testing and preventing gas flow (except vacuum and WAGD) when the latch-valve assembly is removed for service. A 3/8" high metal flange around the outlet opening shall provide a plaster barrier. A temporary cover shall be provided to keep debris out of the outlet during installation. The rough-in assembly shall contain a double

seal to prevent gas leakage between the rough-in and latch-valve assemblies after the wall is finished. A single o-ring seal shall not be acceptable.

4. Latch Valve Assembly: The latch-valve assembly shall include a single compression seal primary valve, be gas specific for the labeled service, and accept only corresponding geometrically shaped hose and apparatus adapters. The latch-valve assembly shall be indexed to the corresponding rough-in assembly to avoid accidental cross-connection and shall telescope up to 3/4" to allow for variation in finished wall thickness from 1/2" up to 1-1/4". A metal cover plate insert with permanent, color-coded marking of service identification shall be included as part of the latch-valve assembly. A pushbutton release mechanism, for disconnecting apparatus, shall be accessible from the top, bottom and side of the outlet.
5. Outlets shall be as manufactured by Puritan Bennett or approved equal.

B. Nitrogen Control Panel:

1. Gas Control Panel: The Puritan Bennett Gas Control Panel shall be designed to provide delivery pressure control of piped gases to turbo-surgical tools. The panel shall contain the following:
 - a. An on-off service ball valve rated at 300 psi maximum working pressure, capable of sealing in both directions. Ball seats shall be of Teflon material.
 - b. A self-relieving-type pressure regulator with a 10 to 250 psi regulating range.
 - c. A 2-1/4" diameter control knob is provided for ease of regulator adjustment.
 - d. Two 0 to 300 psi pressure gauges with dial face increments of 10 psi for visual indication of incoming pipeline pressure and adjusted delivery pressure to the outlet.
 - e. Type K copper tube extensions for connections to a 3/8" nominal gas service line and to a remote outlet location.
 - f. An outlet connection valve consisting of a Diameter-Index Safety System (DISS).
2. The entire control panel shall be cleaned as if for oxygen use and appropriately labeled to avoid errors in gas service connections.
3. Control Panel Design: The control panel front shall be constructed of brush-finished anodized aluminum with a wrap around frame for ease of installation and servicing. A rough-in mounting box shall be included, constructed of 16-gauge steel with powder coated finish. Mounting flanges for anchoring rough in to walls of various construction are attached.

2.6 ZONE VALVE BOXES

- A. Zone Valve and Box Assembly: Valves shall be full port, double seal, ball-type with three piece bronze/brass body and a chrome-plated brass ball. Valves shall be designed for a maximum working pressure of 600 psig WOG or vacuum service to 29" Hg. Valve seals shall be glass-reinforced Teflon materials. All valve materials shall be compatible with USP oxygen, nitrous oxide, medical air, carbon dioxide, helium, nitrogen and mixtures thereof. A 1/4 turn of the handle shall be required to operate the valve from OPEN to CLOSED position. The valve shall be securely attached to the box and provided with type K copper tube extensions for making connection to system piping outside the box. All valves shall be serviceable in the line, supplied clean and prepared for oxygen service. All zone valve assemblies shall include a 1/8" NPT port with pipe plug as a provision for connection of a gauge. The gauge port shall be located on the terminal outlet side of the valve to register pipeline pressure or vacuum. The gauge shall be visible through the door of the zone valve box. The zone valve and box assembly shall meet all requirements of NFPA 99 and CAN/CSA-Z305.1.
- B. Zone Valve Box Design: The zone valve box shall be constructed of 18-gauge steel with white epoxy finish and provided with two galvanized steel brackets that anchors the box to the wall. Anchor brackets shall be designed to permit box assemblies to be ganged together in a vertical stack. Triple valve box assemblies require a rough wall opening of sufficient size to accommodate a nominal 11-7/8" wide x 15-1/2" high x 3-7/8" deep box. The zone valve box assembly shall have a sliding, opaque door with pull ring and clear gauge window. The door shall be capable of sliding to the right or left to facilitate installation requirements. In an emergency, the door shall SNAP-OUT by pulling the pull ring forward without exposing sharp edges. The zone valve box shall be provided with an anodized aluminum trim capable of adjusting to variations in wall thickness up to 1" below flush. The zone valve box assembly shall be supplied with color-coded gas identification labels. The assembly door shall have a label that reads:

- CAUTION -
MEDICAL GAS SHUT-OFF VALVES
CLOSE ONLY IN EMERGENCY

2.7 ALARMS

- A. Medical Electronic Gas Alarm: The alarm panel shall provide master and area alarm signals, as required by the latest edition of NFPA 99 and CSA Standard Z 305.1. The alarm shall be UL listed and CSA Certified. The alarm panel shall meet the FDA Electromagnetic Compatibility Standard for Medical Devices MDS-201-0004 to reduce the possibility of magnetic radiation interference with other equipment. All field wiring and signals shall be self-monitoring and on a closed circuit. Fault signals shall be on an open circuit. The alarm system shall have a modular design allowing modules to be arranged vertically, horizontally, or a combination of both. The finish trim shall consist of a light gray epoxy powder-coated trim plate with an easily removed plastic cover plate.
- B. The Power Supply Module: The power supply module shall convert 120 or 240 VAC to low voltage DC. This module shall contain a fuse to protect the system from power surges. An amber POWER ON indicator shall illuminate when the alarm panel is

powered. The power supply module shall provide an audible signal that is activated by a digital display module or multi-signal alarm module. The audible signal shall have a minimum sound pressure level of 90 dBA measured at a distance of 3 ft (1m).

- C. The Digital Module: The digital display module shall be used as either a master alarm or area alarm. The digital liquid crystal display (LCD) continuously indicates the pressure or vacuum in the piping system being monitored. The display shall be programmable to read psig, in Hg, or kPa in increments of 1 psig, 1 in Hg, or 7 kPa respectively. The digital display module shall provide an audible and visual signal when a fault condition occurs. The digital display module shall be provided with a button to silence the audible alarm. The visual signal shall automatically cancel when the fault is corrected. The visual signals for system pressure or vacuum shall read NORMAL (green LED), LOW (red LED), and HIGH (red LED). Signal limits shall be factory set as required by code and field programmable without the use of tools. Each digital display module shall provide three additional signals with the ability to field label the system function being monitored (i.e., reserve, lag, dew point, etc.). The first signal shall be a yellow LED, the second a red LED and the third a flashing red LED. The green system status NORMAL indicator shall turn off whenever a fault signal is received or flashes upon receipt of an advisory signal (i.e., secondary supply). The alarm shall be of the closed-circuit self-monitoring type, signaling abnormal conditions when the switch contacts are in the open position. The digital display module shall incorporate a self-test function to test LCD, LEDs, audible alarm, and to view the alarm set points. Each digital display module shall be equipped with a general fault relay output (30 VAC/VDC 2A max). Pressure or vacuum signals on one digital display module shall be capable of being monitored by additional digital display modules.
- D. The Sensor Module: The sensor module shall contain a transducer capable of providing calibrated signals to the digital display module. Sensor modules shall be gas specific and be capable mounting directly in the medical gas pipeline or in standard wall construction. Sensor modules may be installed in the ceiling. A sensor module is required for each digital display module. Pipeline connections shall be 3/8" nominal (1/2" OD) type K copper tube. Connectors shall be provided for attaching field wiring. Sensors shall be removable for periodic testing as required by code without the need to change medical gas pipeline pressures or vacuum.
- E. Multi-Signal Alarm Module: The multi-signal alarm module shall be capable of monitoring up to six dry-contact signals. Each signal shall illuminate a green LED to indicate that conditions are normal. When a fault occurs, the green LED shall turn off, the red LED shall illuminate, and the audible alarm shall sound. The red LED can be field programmed to illuminate as solid red or flashing red. Each multi-signal alarm module shall be provided with a button to silence the audible alarm. The visual alarm shall remain illuminated until the fault condition has been corrected. Unused signals shall have the ability to be deactivated in the field. Field programming can be accomplished without the use of tools. The alarm shall be of the closed-circuit self-monitoring type, signaling abnormal conditions when the switch contacts are in the open position. The multi-signal alarm module shall incorporate a self-test function to test LEDs, audible alarm, and signal display mode. Each digital display module shall be equipped with a general fault relay output (30 VAC/VDC 2A max).

PART 3 - EXECUTION

3.1 INSTALLATION: NFPA 99, and CGA P-2.1.

3.2 PIPING

- A. Piping and components shall be cleaned for oxygen service prior to arriving at the job site in accordance with NFPA 99. All material shall remain plugged, capped or otherwise sealed until final assembly. Material shall be visually examined internally for contamination immediately before final assembly. Material which has become contaminated and is no longer suitable for oxygen service shall not be installed. On-site cleaning of the interior surfaces of tubes, valves, fittings or other components shall be limited to recleaning surfaces in the immediate vicinity of joints that have become contaminated prior to brazing. For this cleaning, wash surfaces in a clean, hot water/alkaline solution of sodium carbonate or trisodium phosphate (1 lb. to 3 gal. of potable water). The surfaces shall be thoroughly scrubbed and rinsed with clean, hot, potable water.
- B. Piping Installation: Exercise care with cutting, brushing, and reaming tools and equipment to prevent oil, grease, and dirt from entering pipe and components. Rewash all contaminated pipe and components. Cut pipe square and accurately to measurements and work into place without springing or forcing. Follow the general arrangement indicated. Do not bury embed or conceal piping except as indicated. Do not install piping near high voltage lines. At the end of each work shift shut off valves, and cap or plug open ends. As work progresses valve off each section. Prevent moisture or dirt from entering piping.
- C. Exposed Oxygen Piping: Install in wall mounted sheet steel raceways and junction boxes.
- D. Threaded Joints: Coat male threads of fittings used in shutoff valves with teflon tape before assembly.
- E. Brazing and soldering: Personnel qualification procedures shall conform with AWS B2.2. Metal preparation and joining procedures shall conform with AWS B2.2. Metal preparation and joining procedures shall conform with the CDA 412/6 and NFPA 99. Do not use flux, except those requiring the joining of copper and brass or other dissimilar metals. Completely clean off the excess after brazing and soldering. Apply brazing and soldering alloys in accordance with Table I.

TABLE I

BRAZING AND SOLDERING ALLOY APPLICATIONS

<u>System</u>	<u>Pipe Sizes</u>	
	2-Inch and Smaller	2-1/2 Inch and Larger
Oxygen	BCuP Series	BCuP Series
Nitrogen Oxide	BCuP Series	BCuP Series
Nitrogen	BCuP Series	BCuP Series
Vacuum	Tin-Antimony	BCuP Series
Medical Air	BCuP Series	

- F. Welding: In accordance with AWS B2.1
- G. Purging and Blowing Clear: During brazing, soldering, or welding operation, continuously purge with oil free nitrogen. As each section is completed, blow clear of dirt and contamination with oil-free dry nitrogen in accordance with NFPA-99. Cap or plug open ends, if they are left unattended for any length of time.
- H. Grounding: Ground metal piping systems in accordance with Division 16.
- I. Pitch: Pitch piping in the direction of flow. Do not install any system as to provide a trap.
- J. Changes in size: Effect changes in size with reducing fittings. The use of bushings shall not be permitted.
- K. Supports: Rigidly support all valves and other equipment where installation or operation might strain the pipe.
- L. Pipe sleeves: Provide pipe sleeves where pipes and tubing pass through walls, and partitions. Secure sleeves in proper position and location before and during construction. Drive sleeves of sufficient length to pass through entire thickness of walls, or partitions, and be flush at both ends. Firmly pack the space between the pipe or tubing and the sleeve with oakum and caulk on both ends of the sleeve with plastic cement.
- M. Identification of Piping: Identify all piping with tape and decals conforming with CGA Pamphlet C-9 in lieu of stencils and paint. Provide copies of the piping identification code and piping layout schematic framed under glass and install where directed.
- N. Cleaning, Purging and Blowing Clear: As each section of piping is completed, purge, clean, and blow clear of contaminants in accordance with NFPA 99 using oil-free dry nitrogen. Do not use other gas, neutral, or liquid. Cap or plug open ends if they are left unattended for any length of time.

- 3.3 VALVES: Disassemble all solder socket end valves before brazing, soldering or welding to prevent damage to seats and seals. Except where indicated or in flush wall mounted cabinets, install valves with the stem vertical and with the valves accessible for operation and maintenance. Install strainers on the inlet side of all pressure reducing valves. Provide main gas valves (pressure reducing or flow control) with by-passes and isolation valves to permit main valve maintenance and permit flow to the patient care areas without interruption of gas.
- 3.4 HANGERS AND SUPPORTS: Design, selection, fabrication, and installation of piping hangers and supports shall conform with MSS SP-58 and MSS S-69 except that spacing of the hangers and supports shall be in accordance with Table II. When pipe is installed on trapeze hangers, the hanger spacing shall conform to the requirements of lowest strength pipe.

TABLE II

MAXIMUM SPAN FOR PIPE HANGERS (feet)

Copper tube, Type K (Cu-K) and Type L (CU-L), and brass

<u>Pipe Size</u> (inches)	<u>Cu-k and Brass</u>	<u>Cu-L</u>
1/2	3'-9"	3'-6"
3/4	4'-3"	4'-3"
1	5'-0"	4'-9"
1-1/2	5'-9"	5'-6"
2	6'-6"	6'-6"
2-1/2	7'-3"	7'-0"

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified independent testing and inspecting agency to perform the following field tests and inspections and prepare test reports.
- C. Perform the following field tests and inspections and prepare test reports:
 1. Inspect, test, and certify completed medical gas systems according to requirements in NFPA 99. Inspect, test, and certify each medical gas piping system, including specialties, service connections, alarm system, safety devices, and source equipment.
 2. Provide oil-free dry nitrogen, medical gases, materials, and equipment required for testing.
 3. Level 1 Pressure Medical Gas Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped gas systems. Include the following:

a. Performance Testing:

- (1) Blow Down: Clear piping before connecting service connections or outlets.
- (2) Initial Pressure Tests: Subject each piping section to test pressure of 1.5 times system working pressure, but not less than 150 psig (1035 kPa), before attaching system components, after installing station outlets with test caps (if supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
- (3) Cross-Connection Tests: Determine that no cross connections of piping systems exist. Disconnect all systems except system to be checked. Pressurize system to 50 psig (345 kPa). Verify that gas flow from service connections and outlets is only from system being checked. Repeat for each system. Verify correct labeling.
- (4) Purge Tests: Perform heavy intermittent purging of piping and full-flow purging of service connections.
- (5) Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at 20 percent above normal line pressure. Verify that pressure differences comply with required calibration. Repair leaks with new materials and retest systems.

b. System Verification:

- (1) Cross-Connection Tests: Repeat cross-connection test above or perform alternate tests with each gas at different pressure.
- (2) Flow Tests: Perform flow test at each outlet.
- (3) Valve Tests: Verify proper valve operation.
- (4) Alarm Tests: Operate systems and verify proper warning indication of each medical gas piping system function.
- (5) Piping Purity Tests: Test for dew point and hydrocarbons as compared to source gas.
- (6) Final Tie-End Tests: Verify that above tests have been successfully performed.
- (7) Operational Pressure Tests: Use designated system gases and test for pressure and flow.

- (8) Medical Gas Concentration Tests: Test each gas for required concentration.
 - (9) Labeling: Verify correct labeling.
- 4. Level 1 Vacuum System Testing: Use oil-free dry nitrogen, unless otherwise indicated, and perform procedures and tests as indicated in NFPA 99 performance and testing paragraphs for piped vacuum systems. Include the following:
 - a. Blow Down: Clear piping before connecting service connections or inlets.
 - b. Initial Pressure Tests: Subject each piping section to test pressure not less than 150 psig (1035 kPa) before attaching system components, after installing station outlets with test caps (if supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water. Repair leaks with new materials and retest systems.
 - c. Initial Cross-Connection Tests: Determine that no cross connections of piping systems exist. Disconnect all systems except system to be checked. Pressurize system to 50 psig (345 kPa). Verify that gas flow from service connections and outlets is only from system being checked. Repeat for each system. Verify correct labeling.
 - d. Standing-Pressure Tests: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at not less than 60 psig (415 kPa).
 - e. Final Cross-Connection Tests: Repeat cross-connection test above or perform alternate tests with each system at different pressure.
 - f. Vacuum Tests: Verify functional operation of components.
 - g. Valve Tests: Verify proper valve operation.
 - h. Alarm Tests: Operate systems and verify proper warning indication of each medical gas piping system function.
 - i. Labeling: Verify correct labeling.
- D. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:
 - 1. Inspections performed.
 - 2. Procedures, materials, and gases used.
 - 3. Test methods used.

4. Results of tests.

END OF MEDICAL GAS SYSTEM